

Unlocking the Secrets to Healthy Ageing at the Nexus of Agriculture, Food Science, Nutrition and Health

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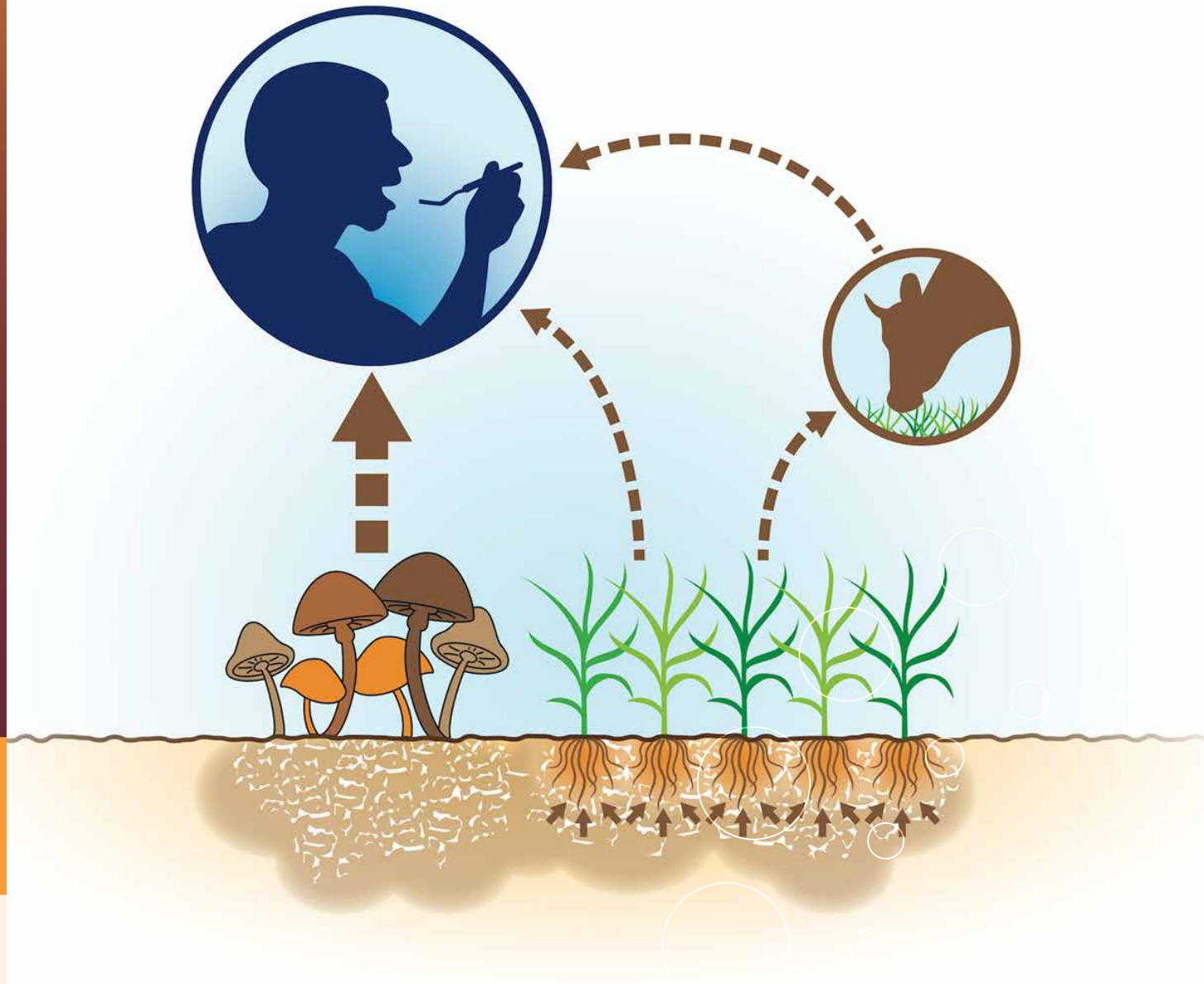
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Dr Robert Beelman is Professor Emeritus of Food Science and the Director of the Center for Plant and Mushroom Foods for Health at Penn State College of Agricultural Sciences. His groundbreaking research on the medicinal properties of mushrooms and vital nutrients like Ergothioneine has opened new pathways in understanding the link between diet, soil health, and human longevity.

The Ergothioneine Breakthrough

In 1909, a fungal metabolite (a substance produced in the process of metabolism) was discovered in a certain group of fungi known as Ergot fungi. This metabolite was appropriately called Ergothioneine (ERGO). For many years, little attention was paid to it until some researchers discovered that it occurred in relatively high concentrations in some animal and human blood samples, and could be traced back to certain foods they consumed.

In 2005, a pivotal discovery revealed that mammals possess a specialised transporter protein for ERGO that rapidly pulls it from food into red blood cells which distribute it to all tissues of the body, where it exerts powerful antioxidant and anti-inflammatory effects. This has led many scientists to highlight the biological importance of ERGO.

Dr Robert Beelman is Professor Emeritus of Food Science and the Director of the Center for Plant and Mushroom Foods for Health at Penn State College of Agricultural Sciences. His vital work on ERGO helped advance the understanding of its role in human health. He has demonstrated that ERGO is a potent dietary antioxidant amino acid – and a lack of it in the diet can result in a greater incidence of chronic diseases, such as ageing and reduced life expectancy.

In his research, Dr Beelman has delved into how ERGO functions within the body and its potential role in preventing chronic age-related diseases. His work has also extended to examining the best dietary sources of ERGO, primarily focusing on mushrooms. He has investigated how different methods of soil preparation and farming practices can influence the fungal populations of soil, subsequently affecting the levels of ERGO in food. This aspect of his

research underscores the significance of sustainable agricultural practices in enhancing the nutritional value of crops, thereby promoting better health outcomes.

ERGO as the ‘Longevity Vitamin’

Biochemist Bruce Ames first hypothesised ERGO as the ‘longevity vitamin’ because its deficiency in the diet would result in cumulative negative health outcomes that can lead to premature ageing. Dr Beelman’s research indicates that ERGO protects cells from oxidative stress and inflammation, key factors in chronic diseases like heart disease, neurodegenerative disorders, and certain cancers. ERGO’s ability to scavenge reactive oxygen and nitrogen species reduces oxidative damage to biological molecules, thus mitigating chronic disease progression.

This hypothesis gains support from evidence showing declining ERGO levels in our blood with age, especially in individuals with degenerative diseases like Parkinson’s disease, Alzheimer’s disease, and cognitive impairment. Dr Beelman references a Swedish study involving over 3,200 individuals, which found that ERGO was the most strongly associated metabolite with reduced mortality and cardiovascular disease risk among 112 analysed. Importantly, this suggests that increasing ERGO levels through diet might lower the risk of cardiovascular diseases and overall mortality.

However, ERGO is not naturally produced in humans and so must be obtained through diet. Dr Beelman sought to identify which foods can provide the highest doses of ERGO – and mushrooms emerged as a primary source.



Mushrooms: A Nutritional Powerhouse

While some foods, like certain beans, animal liver, and oats, all contain ERGO, it is primarily produced in nature by fungi. Since mushrooms are the fruiting bodies of fungi, they are the standout source, particularly varieties like shiitake, oyster, king oyster, maitake, and porcini. In his paper, 'Micronutrients and Bioactive Compounds in Mushrooms', Dr Beelman emphasises mushrooms' rich nutritional profile, which includes not just high levels of ERGO but also vitamins, antioxidants, and bioactive compounds like selenium, vitamin D, and glutathione. This unique combination of nutrients in mushrooms provides an intriguing potential as a dietary solution to improve health outcomes, particularly in ageing populations. Dr Beelman has also explored the bioavailability of ERGO from mushrooms, confirming their importance in the human diet for preventing age-related cognitive decline and neurodegenerative diseases.

The high levels of ERGO and other beneficial compounds in mushrooms mean they are crucial in combating oxidative stress and inflammation. For individuals, this highlights the importance of including mushrooms in our diets, offering potential health benefits that could lead to improved overall health and possibly longer lifespans. With this in mind, Dr Beelman sought to assess the adequacy of ERGO in our current dietary patterns and explore strategies to enhance its presence for improved health outcomes.

ERGO, the American Diet and Soil Health

The American diet is typically low in ERGO, apparently because the dietary patterns in the USA often favour foods that are low in this potent antioxidant and anti-inflammatory compound. It has been estimated that Americans typically consume only about 1 mg of ERGO per day, mainly due to low

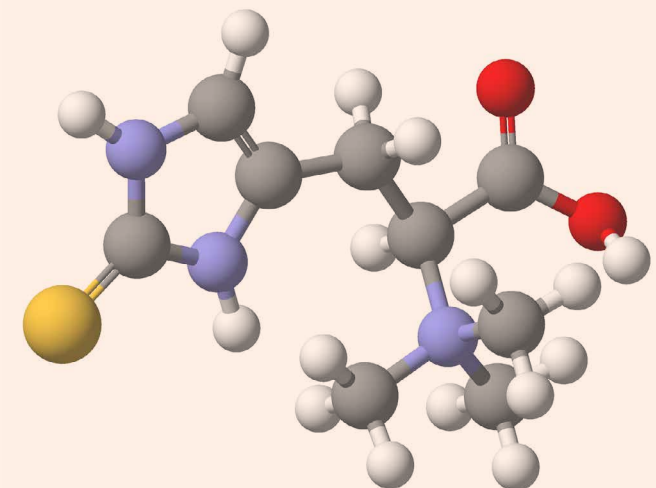
mushroom intake. Comparatively, Italians consume about 5 mg, largely owing to their higher mushroom consumption, which can be attributed to their culinary practices. This disparity underscores the importance of dietary patterns in ERGO intake and the need to spread awareness about how to incorporate ERGO-rich foods into daily diets.

However, when it comes to ERGO consumption, other influential factors come into play, with soil taking centre stage. The Earth's soil is a thriving ecosystem, teeming with a multitude of microorganisms. It is a startling realisation that just one teaspoon of soil harbours a population of microbes that surpasses the total number of people on our planet. Within this rich tapestry of soil life, ERGO finds its place. In his paper titled, 'Soil Disturbance Impact on Crop Ergothioneine Content Connects Soil and Human Health', Dr Beelman hypothesises that soil-borne fungi transfer ERGO to crops through their roots. His research points to how soil management practices – such as the intensity of the breaking up and overturning of soil, also known as tillage – exert a direct and profound influence on the ERGO.

In a long-term study, Dr Beelman examined different tillage intensities, finding that ERGO concentrations in corn, soybeans, and oats decreased by approximately 30% with increased tillage intensity. This finding suggests that aggressive ploughing might negatively affect soil fungi, which is crucial for ERGO levels in crops. His findings suggest that no-tillage farming practices, which minimise soil disturbance, lead to higher concentrations of ERGO in crops. Dr Beelman proposes that this research emphasises the need for regenerative or restorative agricultural practices, which include no-till or minimal tillage, use of cover crops, multiple crop rotations, and reduced chemical inputs. Such practices help maintain healthy microbial populations in farm soils and overall soil health.

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Dr Beelman highlights that there is ongoing interest in the scientific community in exploring the association between soil health and human health. He believes that ERGO may well be a definitive connection, and that understanding how to increase ERGO content in the American diet could be transformative in improving long-term health outcomes.



L-Ergothioneine (ERGO)



MEET THE RESEARCHER

Dr Robert B Beelman, Professor Emeritus of Food Science, Director, Center for Plant and Mushroom Foods for Health, Penn State College of Agricultural Sciences, University Park, PA, USA

Dr Beelman highlights that there is ongoing interest in the scientific community in exploring the association between soil health and human health. He believes that ERGO may well be a definitive connection, and that understanding how to increase ERGO content in the American diet could be transformative in improving long-term health outcomes. By showing how agricultural practices can enhance the nutritional value of commonly consumed crops, his work paves the way for dietary improvements that could combat chronic diseases and improve overall health outcomes worldwide. This approach to agriculture highlights the potential of altering dietary guidelines and public health discussions to include ERGO and its significance in human health.

Paving the Path for Future Research

Dr Robert Beelman's research stands at the crossroads of agriculture, nutrition, and health. His work not only illuminates the intricate connections between these domains but also guides future scientific inquiries. In the past, fungi that produced penicillin played a pivotal role in improving public health when infectious diseases posed a significant threat. However, today, chronic inflammatory diseases have become widespread, affecting 70% of Americans. In this context, the presence of ERGO-producing fungi in our agricultural soils may bring about a more subtle yet potentially enduring enhancement in our overall health outcomes. Dr Beelman's research challenges us to reconsider the impact of our dietary choices and farming practices on our well-being, with the potential for profound and lasting improvements.

Dr Robert Beelman is a distinguished figure in the field of food science. His academic journey began with a BS in Biology from Capital University, followed by an MS and a PhD in Food Technology from The Ohio State University. Dr Beelman works on enhancing the nutritional and medicinal value of cultivated mushrooms, exploring regenerative agricultural practices to improve nutrient density in the food supply, and evaluating ergothioneine as a potential longevity vitamin to mitigate chronic diseases of ageing. He has hypothesised a significant role for soil-borne fungi in increasing ergothioneine levels in crops, which is crucial for human health. His advocacy extends into the realm of regenerative farming, emphasising the reduction of severe tillage, the use of cover crops, and minimising synthetic fertilisers and pesticides to boost soil health and, consequently, human health. Dr Beelman's scholarly contributions not only shed light on the importance of mushrooms and soil health in our diet but also transform our understanding of nutrition and its impact on long-term health outcomes.

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FURTHER READING

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